New species of *Ilyograpsus* from the Ryukyu Islands, Japan, with notes on *I. nodulosus* Sakai, 1983

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Abstract.— A new species of the genus *Ilyograpsus* is described from the Ryukyu Islands. *Ilyograpsus paantu*, new species, can be easily distinguished from all congeners by its longitudinal postfrontal cristae and relatively longer carapace. *Ilyograpsus nodulosus* was originally described from damaged juveniles, there had been no information on adult males. Present study provides diagnosis of the species based on topotypic specimens, including adult males, and compares the species with all congeners.

Introduction

The genus *Ilyogrpasus* Barnard, 1955, is represented by four species, *I. paludicola* (Rathbun, 1909), *I. rhizophorae* Barnard, 1955, *I. nodulosus* Sakai, 1983, and *I. vanninii* Sawada, Hosogi & Sakai, 2005. *Ilyograpsus rhizophorae* had been regarded as a junior synonym of *I. paludicola* by Crosnier (1965), but Sawada *et al.* (2005) resurrected it. They also described *I. vanninii* from Sinai Peninsula to East Africa. However, the differences between *I. paludicola* s. str. and *I. rhizophorae* are still not clear and it will be necessary to revise their taxonomy with due consideration of sexual dimorphism, size and geographical variations (see Sawada *et al.*, 2005). The genus is now being revised by Dr. T. Komai (Natural History Museum and Institute, Chiba, Japan). *Ilyograpsus nodulosus* was originally described from two damaged juveniles from Iriomote Island, Ryukyu Islands, Japan, and Sakai (1983: 42) commented that the species will need to be redescribed when adults are found. Sawada *et al.* (2005) redescribed *I. nodulosus* based on female specimens from Japan, New Caledonia, and Australia, and males from Australia. Male specimens of *I. nodulosus* sensu Sawada *et al.* (2005) from Australia, however, appear rather distinct from females from Japan in the granulation of infraorbital margin (Sawada *et al.* 2005: Fig. 5A). Since the holotype of *I. nodulosus* has been lost (Sawada *et al.*, 2005; T. Sato pers. comm.; also see Muraoka, 1998), there is still in need to redescribe the species using male topotypic specimens. In the course of the faunal survey of terrestrial to intertidal crabs, we obtained numerous specimens of *I. nodulosus* and an undescribed species of *Ilyograpsus* from Okinawa, Iriomote, and Amami-Ohshima islands, Ryukyu Islands, Japan. In the present study, we describe the new species and rediagnose *I. nodulosus*.

Materials and Methods

Specimens were collected from the Ryukyu Islands, Japan (Fig. 1) and have been deposited at the Natural History Museum and Institute, Chiba, Japan (CBM), the Ryukyu University Museum, Fujukan, Okinawa, Japan (RUMF), and the Zoological Reference Collection, Raffles Museum of Biodiversity Research, National University of Singapore, Singapore (ZRC). The abbreviations CL, CW, G1, and G2 are used for carapace length, carapace width, male first gonopod, and male second gonopod, respectively. All characters were measured to the nearest 0.1 mm using a stereomicroscope (Nikon SMZ-10) equipped with an eyepiece micrometer. For ratio values, both the range and the

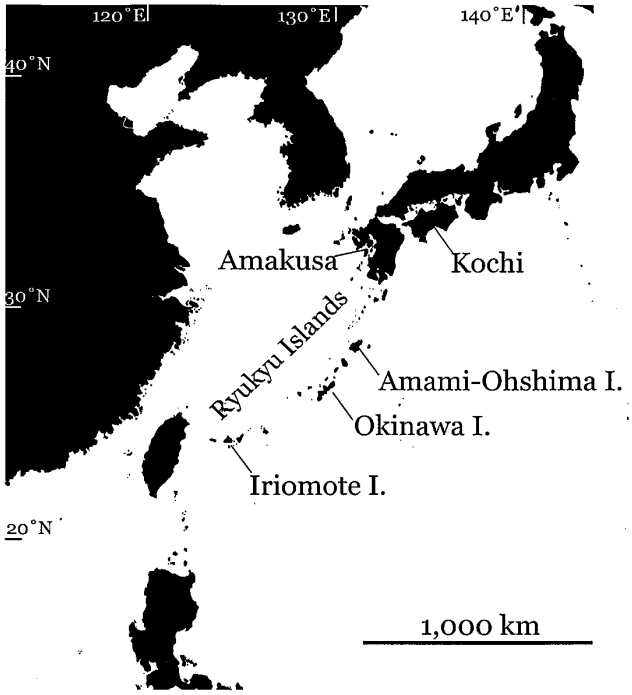

Fig. 1. Sampling localities in East Asia.

mean (in brackets) are provided.

Taxonomy

Macrophthalmidae

Ilyograpsus Barnard, 1955

Ilyograpsus paantu, new species
(Figs. 2a, 3, 4)

Ilyograpsus paludicola— ?Nakasone & Irei, 2003: 273.

Material examined.— Holotype: 1 male, CL 3.4 mm, RUMF-ZC-237, Tima River, Okinawa Island, coll. T. Naruse, 13 Feb. 2005. Paratypes: 1 male, CL 3.4 mm, 2 females, CL 4.7, 5.8 mm, 3 ovigerous females, CL 4.7–5.6 mm, RUMF-ZC-238, data same as holotype; 1 female, CL 4.1 mm, RUMF-ZC-239, Shira River, Iriomote Island, coll. T. Naruse & T. Nagai, 22 Dec. 2004; 3 males, CL 2.6–3.2 mm, 3 females, CL 4.6–5.0 mm, CBM-ZC 8491, Tima River, Okinawa Island, coll. T. Naruse, 8 Dec. 2004; 1 female, CL 5.4 mm, CBM 8492, Adetsu River, Amami-Ohshima Island, coll. Y. Yonezawa, 4 Aug. 2000; 1 female, CL 6.4 mm, CBM 8493, Yannma, Amami-Ohshima Island, coll. T. Kishino, 31 Mar. 2002; 2 males, CL 3.2, 3.6 mm, ZRC 2005.0112, Tima River, Okinawa Island, coll. T. Naruse, 25 Dec. 2004.

Description.— Carapace (Figs. 2a, 3a) pear-shaped, longer than broad, CW/CL ratio 0.89–0.96 (mean 0.94, n = 20). Dorsal surface of carapace rough; front medially concave posteriorly in dorsal view and inferiorly in frontal view, frontal width 0.32–0.43 (mean 0.40, n = 20) times fronto-orbital width, front to mesogastric regions sloped towards midline, post frontal and epigastric regions each with a pair of longitudinal and oblique cristae, respectively; mesogastric regions with V-shaped cristae (Fig. 3a). Post frontal crista lined with several long setae, of which one is prominently long (Figs. 2a, 3b). Cardiac region with two pairs of nodules, epibranchial and mesogastric regions with a pair of nodules, intestinal region with inverted Y-shaped crista; posterolateral region with a long crista in parallel with posterolateral margin. Supraorbital crista rimmed, inner angle about 90°; infraorbital margin (Fig. 3b) complete, lined with small granules, without any large granules, vertically sinuous near external end in anterior view. Anterolateral margin (Fig. 3a) with four teeth including external orbital angle (= first tooth), first tooth acute, directed anterolaterally, second and third teeth blunt, second tooth small, placed closer to third tooth, third tooth faint, invisible in some specimens, fourth tooth acute.

Eye (Fig. 3a, b) relatively small, greatest width of cornea narrower than basal width of peduncle in dorsal view when eye in orbit.

Antennule (Fig. 3b) with sub triangular subcoxa, subcoxa longer than broad, endopod with triangular flagellum, inner margin lined with long setae.

Antenna (Fig. 3a, b) long, reaching beyond distal end of eye when eye and antenna directed laterally.

Third maxilliped (Fig. 3b) broad; outer margin of ischium longer than inner margin,

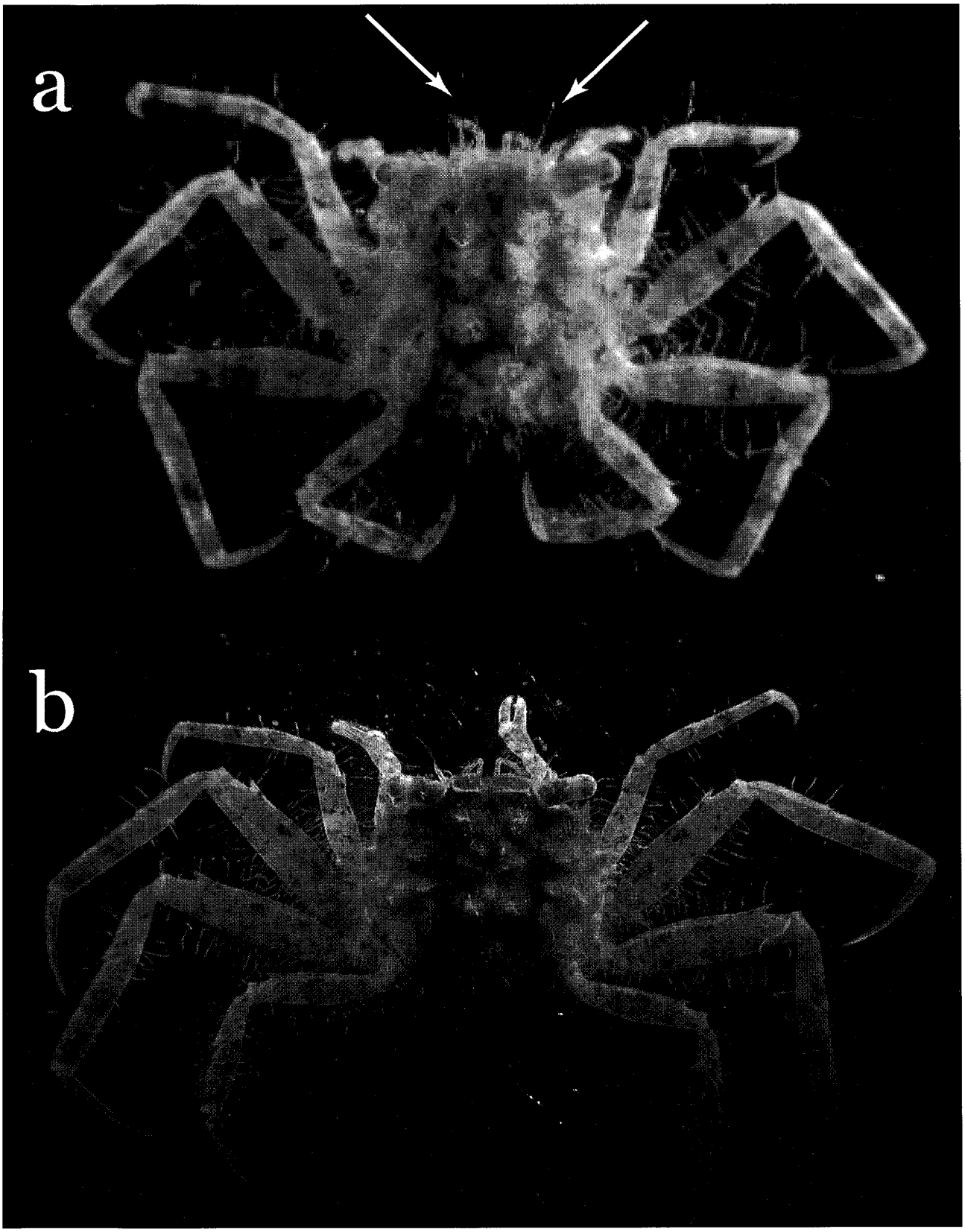

Fig. 2. *Ilyograpsus paantu*, new speices, and *Ilyograpsus nodulosus* Sakai, 1983. a, *I. paantu*, new species, paratype female, CL 4.7 mm, RUMF-ZC-238; b, *I. nodulosus*, female, CL 6.1 mm, RUMF-ZC-242. Arrows indicate prominent setae from postfrontal cristae.

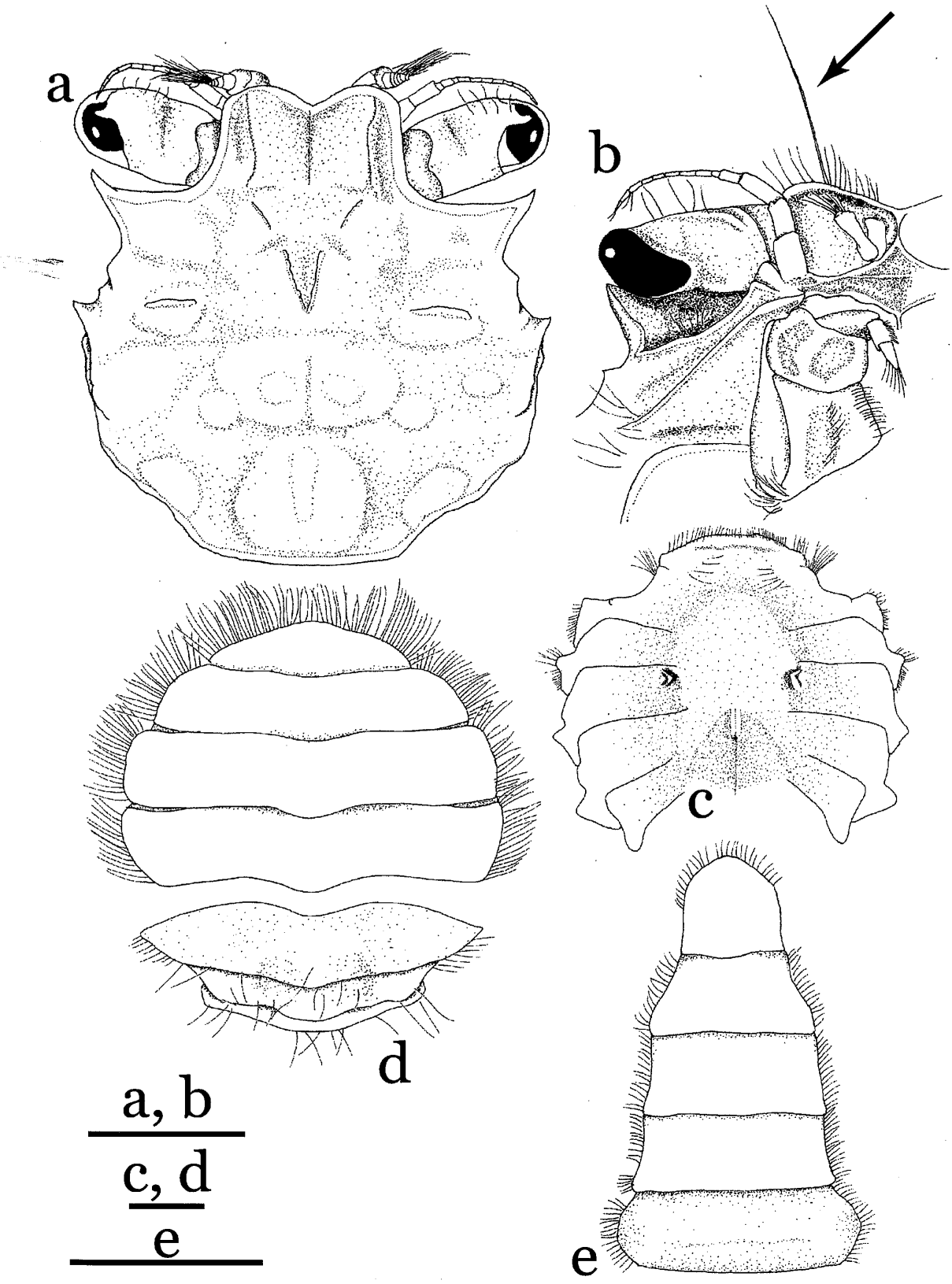

Fig. 3. *Ilyograpsus paantu*, new speices. a, carapace dorsal view; b, carapace frontal view; c, female thoracic sternites; d, female telson and abdomen; e, male telson and abdomen. a, paratype male, CL 3.2 mm, ZRC 2005.0112; b–d, paratype female, CL 5.8 mm, RUMF-ZC-238; e, holotype male, CL 3.4 mm, RUMF-ZC-237. Scales: 1 mm. Arrow indicates prominent seta from postfrontal crista.

median length longer than that of merus; merus somewhat expanded at anterior outer angle.

Cheliped symmetrical in both sexes, only slightly more robust in males than in females; merus subcylindrical with flat ventral surface, distal inner margin without serration nor dilation, subdistal dorsal tooth absent; carpus slender, as wide as merus width, inner tooth absent; chela (Fig. 4a) feeble, palm with smooth surfaces, longer than fingers; fingers becoming flat distally, incurved, distal part spoon-shaped, inner edges without tooth in both males and females.

Ambulatory legs (Fig. 4b) long, second and third ambulatory legs longest; meri each with a acute subdistal tooth, anterior margin sinuous, posterior margin straight, narrowest at level of proximal to subdistal tooth, widest at proximal two-fifths, with long plumose setae along both anterior and posterior margins; carpi and propodi smooth, cross-section subcylindrical, fourth ambulatory leg with plumose setae on anterior and posterior margins. Dactyli simple, thin, incurved, length of midline of dorsal surface of third leg 0.58–0.73 times (mean 0.66, n = 9) that of propodus.

Female thoracic sternum (Fig. 3c) with broad median invagination, with flattened sternites four to six, gonopore placed close to anterior margin of thoracic sternite six (Fig. 3c), with protuberant inner margin, roof-like, opening outwards. Female abdomen (Fig. 3d) subcircular, all segments articulated.

Male abdomen (Fig. 3e) narrow, third segment bent longitudinally, lateral margins medially convex; sixth segment abruptly narrowed along distal half.

G1 (Fig. 4c, d) straight, medially narrowed, distal end scoop-shaped, directed dorsal-outwards.

Habitat.— *Ilyograpsus paantu*, new species, was collected from riverbeds of brackish waters, with a pebbly-muddy substratum. Surprisingly, *Ilyograpsus paantu* was collected sympatrically with *I. nodulosus* in Iriomote, Okinawa, and Amami-Ohshima Islands. One of us (TN) collected large number of both species from Tima River, Okinawa Island by dredging substratum from about depth of one meter. *Ilyograpsus paantu* and *I. nodulosus* seems to dwell patchily on substratum, but no special difference have been observed for their ecology and/or habitat preferences.

Distribution.— Iriomote, Okinawa, and Amami-Ohshima islands, Ryukyu Islands, Japan (present study).

Etymology.— The species name of *Ilyograpsus paantu* is derived from the local god of Miyako Island "Paantu", who is credited with his apotropaic power. Paantu is wholly covered with mud and wrapping himself up with the liana, *Derris trifoliata* (Leguminosae). The species name alludes to Paantu's muddy appearance, and is used as a noun in apposition.

Remarks.— *Ilyograpsus paantu*, new species, is characteristic in having a longitudinal postfrontal crista which extends onto the epigastric region and the carapace being longer than wide (CW 0.89–0.96 times CL). In other congeneric species, the postfrontal crista is L-shaped or transverse; the carapace is wider than long. The new species can be also differentiated from sympatric *I. nodulosus* s. str. (see Remarks part of *I. nodulosus*) (Table 1), by the relatively smaller third anterolateral tooth (smaller than the first tooth in *I. paantu* vs. subequal with first tooth in *I. nodulosus*), the position of the tip of the second tooth (situated closer to the third tooth in *I. paantu* vs. equidistant from first and third teeth in *I. nodulosus*), the presence of the long seta on the postfrontal crista (vs. absent), the subdistal tooth of the anterior margin of ambulatory meri being placed closer to the distal end (further from the distal end in *I. nodulosus*), the shape of the G1 (curving outwards and gently tapering distally in *I. paantu* vs. straight with a medial constriction in *I. nodulosus*), and the position of the gonopore (placed closer to anterior margin of sternite six in *I. paantu* vs. distal one third of sternite six in *I. nodu-*

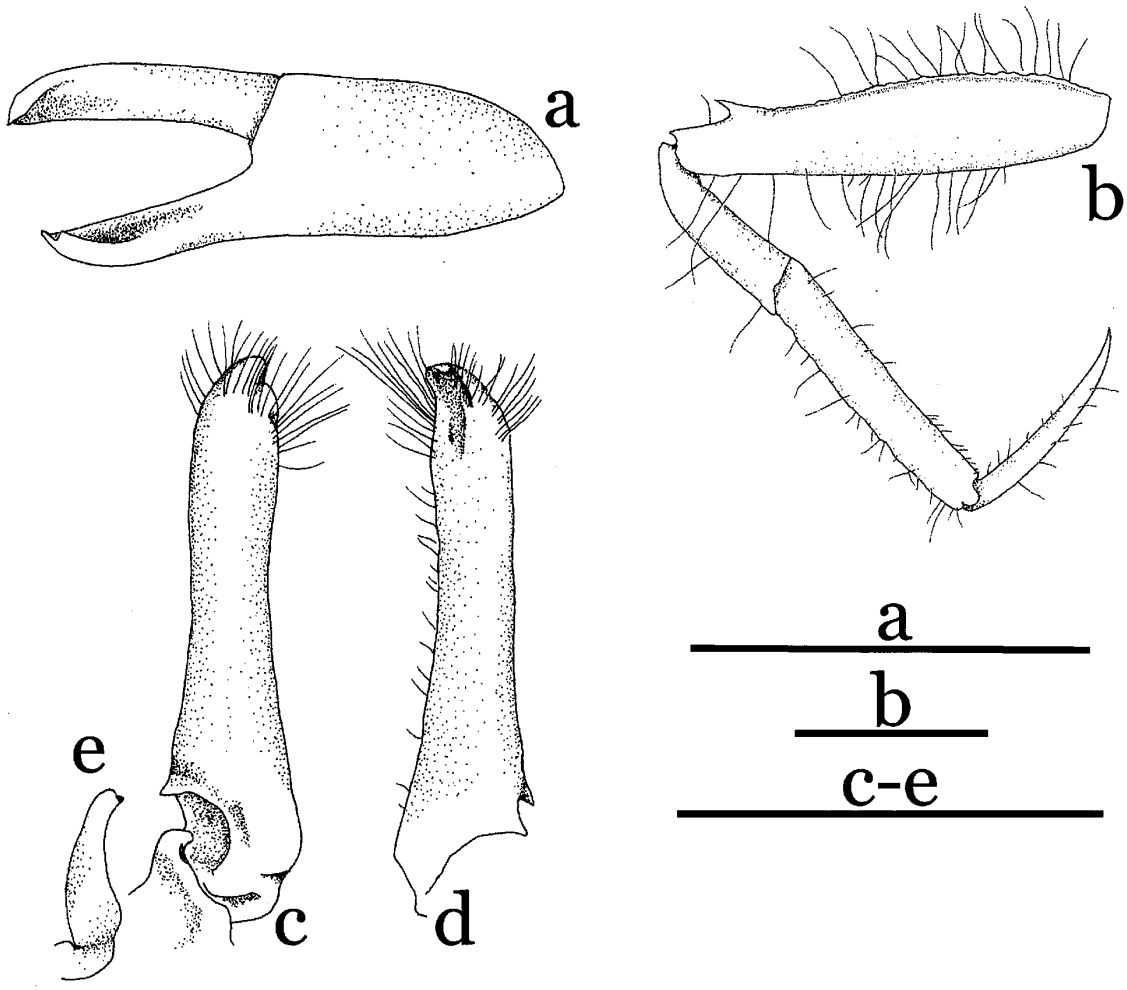

Fig. 4. Appendages of *Ilyograpsus paantu*, new speices. a, right chela, inner view; b, left third ambulatory leg, dorsal surface; c, left G1, ventral view; d, left G1, dorsal view; e, G2. a, c–e, holotype male, CL 3.4 mm, RUMF-ZC-237; b, paratype male, CL 3.2 mm, ZRC 2005.0112. Scales: 1 mm.

losus). These differences are consistently observed in the good series of *I. paantu* and *I. nodulosus*, and it is thus clear that these characters are not associated with size or sexes.

The phylogenetic position of *Ilyograpsus* is still uncertain at present. Rathbun (1909) described the first species of *Ilyograpsus* as a varunine, *Camptandrium paludicola*. Tesch (1918) mentioned that *Camptandrium paludicola* should be referred to Cyrtograpsus Dana, 1851 (presently classified as Varunidae). Subsequently, Barnard (1955), with emphasis on the presence of a complete lower orbital border, assigned his new genus *Ilyograpsus* (type species: *I. rhizophorae* Barnard, 1955, by original designation) to the Grapsinae of the family Grapsidae. This subfamilial assignment was followed by Crosnier (1965). *Ilyograpsus* has also placed in the Varuninae (Guinot, 1967; Yeo *et al.*, 2004) or Grapsidae (Takeda & Nunomura, 1976; Yamaguchi *et al.*, 1976; Yamaguchi *et al.*, 1987). On the other hand, Fukuda (1978; also see remarks section of *I. nodulosus* below) and Flores *et al.* (2003) suggested that the larval morphology of *Ilyograpsus paludicola* is similar to that of ocypodid *Macrophthalmus* Desmarest, 1823 (see also Cuesta *et al.*, 1997). Kitaura *et al.* (2002) showed the phylogenic relationship of grapsoid and ocypodoid crabs and sug-

Table 1. Differences between *Ilyograpsus paantu*, new species, and *I. nodulosus* Sakai, 1983.

	I. paantu, new species	*I. nodulosus* Sakai, 1983
CW/CL ratio	Mean 0.94 (0.89–0.96)	Mean 1.13 (1.08–1.16)
Postfrontal crista	Longitudinal + oblique	Laterally facing L-shape + oblique
Long seta of postfrontal crista	Present	Absent
Size of external orbital angle (first anterolateral tooth)	>3rd tooth	=3rd tooth
Relative position of subdistal tooth of ambulatory meri	Closer to distal end	Farer from distal end
G1	Straight, medially constricted	Curving outwards, gently tapering distally
Gonopore	Placed on distal 1/3 of thoracic sternite 6	Placed close to anterior margin of thoracic sternite 6

gested that *Macrophthalmus* should be placed in its own family. This was also supported by Schubart *et al.* (2006), and they began to implement the raise of all ocypodid subfamilies to family level (Schubart *et al.* 2006: 198). In the present study, with emphasis on larval morphology (Fukuda, 1978; Flores *et al.*, 2003), as well as characters of adult chela and ambulatory legs, we refer *Ilyograpsus* to Macrophthalmidae.

Ilyograpsus nodulosus Sakai, 1983 (Figs. 2b, 5)

Ilyograpsus nodulosus— Sakai, 1983: 18, 42, Pl. VI(E); Kishino *et al.*, 2001: 16, Pl. 1(4); Kishino *et al.*, 2001: 126; Nakasone & Irei, 2003: 273; Sawada *et al.*, 2005: 857 (partim), Figs. 2A, 3B, 4C?; Naruse, 2005: 221.

Ilyograpsus paludicola— Yamaguchi *et al.*, 1976: 41, Fig. 2(8); ?Fukuda, 1978: 15; Yamaguchi *et al.*, 1987: 31, Pl. 14 (Fig. 8).

nec *Ilyograpsus nodulosus*—Sawada *et al.*, 2005: Fig. 5A, C, E.

Material examined.— Ten males, CL 2.6–3.8 mm, 9 females, CL 3.2–4.4 mm, RUMF-ZC-240, Shira River, Iriomote Island, coll. T. Naruse & T. Nagai, 23 Nov. 2004; 1 male, CL 3.4 mm, RUMF-ZC-241, Oura River, Okinawa Island, coll. T. Naruse, 8 Dec. 2004; 1 female, CL 6.1 mm, RUMF-ZC-242, Tima River, Okinawa Island, coll. T. Naruse, 24 Apr. 2005; 1 male, CL 3.1 mm, CBM-ZC 8494, Utara River, Iriomote Island, coll. T. Naruse & T. Nagai, 23 Nov. 2004; 4 males, CL 3.1–3.4 mm, CBM-ZC 8495, Tima River, Okinawa Island, coll. T. Naruse, 25 Dec. 2004; 2 males, CL 4.0, 4.1 mm, ZRC 2005.0113, Tima River, Okinawa Island, coll. T. Naruse, 8 Dec. 2004; 2 females, CL 4.2, 4.3 mm, ZRC 2005.0114, Tima River, Okinawa Island, coll. T. Naruse, 13 Feb. 2005.

Diagnosis.— Carapace (Figs. 2b, 5a) subquadrate, as long as broad, CW/CL ratio 1.08–1.16 (mean 1.13, n = 29). Dorsal surface of carapace rough; front medially concave, frontal width 0.33–0.43 (mean 0.38, n = 29) times fronto-orbital width, front to mesogastric regions flat, with medial shallow groove, post frontal and epigastric region each with a pair of transverse and oblique cristae, respectively; post frontal crista granulated, outer end curving anteriorly, without long setae. Posterolateral region with a long crista in parallel with posterolateral margin. Infraorbital margin (Fig. 5b) complete, lined with small granules, without any large granules, vertically sinuous near external end in anterior view. Anterolateral margin (Fig. 5a) with four teeth including external orbital angle (= first tooth), first tooth as large as third, larger than others, tips acute, directed anterolaterally, widest level of carapace between third teeth, second tooth with rounded tip, tip placed equidistant from

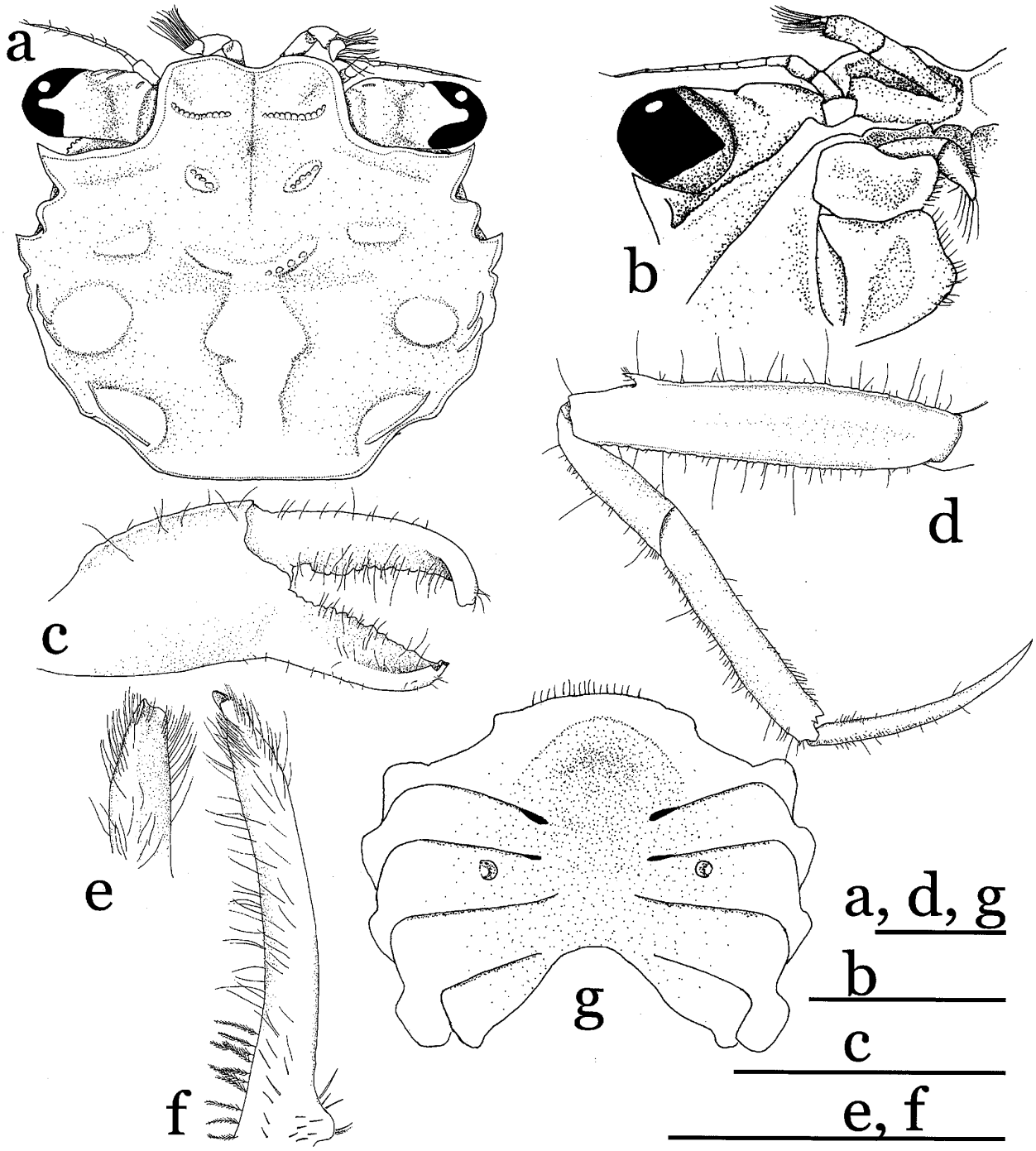

Fig. 5. *Ilyograpsus nodulosus* Sakai, 1983 from Iriomote Island (type locality) (RUMF-ZC-240). a, carapace, dorsal view; b, carapace, frontal view; c, left chela, inner view; d, left third ambulatory leg, dorsal surface; e, distal part of left G1, ventral view; f, left G1, dorsal view; g, female thoracic sternites. a–d, male, CL 3.4 mm; e, f, male, CL 3.8 mm; g, female, CL 3.9 mm. Scaels, 1 mm.

those of first and third teeth. Cheliped symmetrical in both sexes, only slightly more robust in males than in females; merus subcylindrical with flat ventral surface, distal inner margin lined with small granules in males, but never serrated, without dilation, distal dorsal part without tooth; chela (Fig. 5c) with spoon-shaped fingers, inner edges lined with low teeth proximally in males, no tooth in females. Ambulatory meri (Fig. 5d) each with an acute subdistal tooth, meri narrowest at level of distal to subdistal tooth. Dactyli incurved, long, length of midline of dorsal surface of third leg 0.84–0.90 (n = 2) times that of propodus. G1 (Fig. 5e, f) curving outwards, gently tapering distally, distal end spoon-shaped, ventral surface longer than that of dorsal. Gonopore placed distal one third of thoracic sternite six (Fig. 5g).

Habitat.— See Habitat section of *Ilyograpsus paantu*, new species.

Distribution.— Ryukyu Islands [Iriomote (type locality), Okinawa, and Amami-Ohshima Islands], Kyushu (Amakusa I., Kumamoto, East China Sea coast), Shikoku I. (Kochi, Pacific Ocean coast), Japan (present study; Yamaguchi *et al.*, 1976; Sawada *et al.*, 2005); New Caledonia? (Sawada *et al.*, 2005).

Remarks.— The good series of *I. nodulosus* obtained fits well with Sakai's (1983) description. As Sawada *et al.* (2005) showed, *I. nodulosus* can be easily distinguished from *I. paludicola*, *I. rhizophorae*, and *I. paantu* by the presence of distinct nodules on the dorsal surfaces of the carapace and the presence of two pairs of post frontal cristae. Furthermore, *I. nodulosus* differs from those three species in various characters, such as the configuration of the anterolateral teeth, ornamentation of the chelipedal merus, and dentation of the fingers of chela (Table 2).

Sawada *et al.* (2005) discussed the

Table 2. Diagnostic characters of *Ilyograpsus* species.

	I. paantu	*I. nodulosus*	*I. paludicola*	*I. rhizophorae*	*I. vanmiii*
Dorsal surface of carapace	With distinct nodules and ridges	With distinct nodules and ridges	Ornamented with few but regularly placed tubercules	With short sparse pubescence	Almost smooth
Post frontal cristae	2 pairs; former longitudinal, latter oblique	2 pairs; former laterally-facing L-shaped, latter oblique	1 transverse pair	1 transverse pair	1 transverse pair
Position of tip of 2nd anterolateral tooth	Closer to 3rd tooth	Equidistant from 1st and 3rd teeth	Closer to 3rd tooth	Closer to 3rd tooth	Equidistant from 1st and 3rd teeth
Infraorbital margin	Lined with small granules	Lined with small granules	not known	With two triangular convexes in male	Dentate in females
Chelipedal merus: subterminal dorsal spine	Absent in both sexes	Absent in both sexes	Present in female, not known in male	not known in both sexes	not known in both sexes
Chelipedal merus: anterior margin	No granules nor dilation in both sexes	Granulated in male, not in female; no dilation	not known	Crenulate and dentate and delated in male, not known in female	Dentate in female, not known in male
Chelipedal fingers: cutting edges	No tooth in both sexes	Male with teeth, female with no tooth	Teeth on female; not known in male	Dentate, with broad tooth on proximal part in male, not known in female	Obscurely dentate in female, not known in male
G1	Straight, medially constricted	Curving outwards, gently tapering distally	not known	Gently tapering distally, distal part sinupus	Gengly curving, but distal part directing distally

differences between male *I. nodulosus* and other species based on the material collected from Queensland, Australia (p. 861, Fig. 5A, C, E). Male specimens from Queensland, however, differ remarkably from topotypic males of *I. nodulosus* in the presence of large teeth on the outer two-thirds of the infraorbital margin (vs. infraorbital margin lined with small granules, but no large tooth) and the distal end of the G1 being uniformly broad (vs. distal end spoon-shaped). The differences in such important characters suggest that the specimens from Australia are most probably not *I. nodulosus* but an undescribed species. Sawada *et al.* (2005) also examined specimens from New Caledonia and identified them as *I. nodulosus*, but these show minor variations in the shape of the anterolateral teeth, marginal edge of the carapace and form of the ambulatory legs. It is necessary to reassess the identity of New Caledonia specimens to see what species it really is.

Yamaguchi *et al.* (1976) recorded *I. paludicola* from Ike I., Amakusa, Kyushu, Japan. Their specimen, however, has laterally-facing L-shaped postfrontal crista [Yamaguchi *et al.*, 1976: Fig. 2(8); Yamaguchi *et al.*, 1987: Pl. 14 (Fig. 8)], and are most probably *I. nodulosus* instead. Fukuda (1978) studied the larval development of *I. paludicola* based on the material collected from Mae I., Amakusa, which is close to where Yamaguchi *et al.* (1976) reported *I. nodulosus*. Fukuda's (1978) record of *I. paludicola* is perhaps that of *I. nodulosus* as well.

Nakasone (1977) recorded *I. paludicola* from Okinawa Island, and then, Shokita (1990) reported *I. nodulosus* and *I. paludicola* from Iriomote Island, but they did not provide a description nor figure and their material is almost certainly lost (Y. Nakasone, personal communication; S. Shokita, personal communication). Since *I. nodulosus* and *I. paantu* are collected sympatrically from both Okinawa and Iriomote Islands, these two species might be mixed in the records of Nakasone (1977) and Shokita (1990).

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Literatured Cited

Barnard, K. H., 1955. Addition to the fauna-list of South African Crustacea and Pycnogonida. Annals of the South African Museum, 43: 1–107, pl. 1.

Crosnier, A., 1965. Crustacés Décapodes, Grapsidae et Ocypodides. Fauna de Madagascar, 18: 1–143, pls. 1–11.

Cuesta, J. A., Gonzales-Gordillo, J.I., & Rodriguez, A., 1997. First zoeal stages of *Grapsus adscensionis* (Osbeck) and *Planes minutus* (Linnaeus) (Brachyura: Grapsidae) described from laboratory hatched material, with notes on larval characters of the Grapsidae. Journal of Natural History, 31: 887–900.

Desmarest, A. G., 1823. Dictionnaire des

Sciences Naturelles, 28: 138–425. F. G. Levreault, Paris. (not seen)

Flores, A. A. V., Paula, J., & Dray, T., 2003. First zoeal stages of grapsoid crabs (Crustacea: Brachyura) from the East African coast. Zoological Journal of the Linnean Society, London, 137: 355–383.

Fukuda, Y., 1978. Preliminary notes on recently obtained larvae of brachyuran Crustacea of the sea around the Aitsu Marine Biological Station. Calanus, 6: 10–16. (in Japanese with English abstract)

Guinot, D., 1967. La faune carcinologique (Crustacea Brachyura) de l'Océan Indien occidental et de la Mer Rouge. Catalogue, remarques biogéographiques et bibliographie. C.S.A. Specialist Meeting on Crustaceans. Zanzibar, 19–26 IV 1964: 235–352.

Kishino, T., Nomoto, A., Kimura, S., Yonezawa, T., & Wada, K., 2001. Brachyuran crab species recorded in the brackish waters of Amami-Oshima Island, Kagoshima Prefecture, Japan. Nankiseibutsu, 43: 125–131. (in Japanese)

———, Yonezawa, T., Nomoto, A., Kimura, S., & Wada, K., 2001. Twelve rare species of brachyuran crabs recorded in the brackish waters of Amami-Oshima Island, Kagoshima Prefecture, Japan. Nankiseibutsu, 43: 15–22. (in Japanese)

Kitaura, J., Wada, K., & Nishida, M., 2002. Molecular phylogeny of grapsoid and ocypodoid crabs with special reference to the genera *Metaplax* and *Macrophthalmus*. Journal of Crustacean Biology, 22: 682–693.

Muraoka, K., 1998. Catalogue of the Brachyuran and Anomuran crabs donated by Prof. Dr. Tune Sakai to the Kanagawa Prefectural Museum. Catalogue of the Collection in the Kanagawa Prefectural Museum of Natural History, 11: 1–67, pls 1–11.

Nakasone, Y., 1977. Crab zonation in the Yuhi River, Okinawa Island. Japanese Journal of Ecology, 27: 61–70.

———, & Irei, M., 2003. Grapsidae. In: M. Nishida, N. Shikatani, & S. Shoktia (eds.), The Flora and Fauna of Inland Waters in the Ryukyu Islands. Tokai University Press, Tokyo, pp. 272–282. (in Japanese)

Naruse, T., 2005., *Ilyograpsus nodulosus*. In: Okinawa Prefectural Government (Nature Conservation Division, Department of Cultural and Environmental Affairs,) (ed.), Threatened Wildlife in Okinawa, 2nd ed. (Animals) —Red Data Okinawa. Okinawa Prefectural Government (Nature Conservation Division, Department of Cultural and Environmental Affairs), Naha, 221. (in Japanese)

Rathbun, M. J., 1909. New crabs from the Gulf of Siam. Proceedings of the Biological Society of Washington, 22: 107–114.

———, 1910. The Danish expedition to Siam 1899–1900, V. Brachyura. Kongelige Danske Videnskabernes. Selskabs Skrifter, Kjobenhavn, (7)5(4): 301–367, pls. I–II.

Sakai, T., 1983. Descriptions of new genera and species of Japanese crabs, together with systematically and biogeographically interesting species. (I). Research on Crustacea, 12: 1–44, pls. I–VIII, 1 frontispiece.

Sawada, T., Hosogi, M., & Sakai, K., 2005. A new species of the genus *Ilyograpsus*, *I. vanninii* sp. nov. (Brachyura, Grapsidae) from Somalia. Crustaceana, 78: 851–864.

Schubart, C. D., Cannicci, S., Vannini, M., & Fratini, S., 2006. Molecular phylogeny of grapsoid crabs (Decapoda, Brachyura) and allies based on two mitochondrial genes and a proposal for refraining from current superfamily classification. Journal of Zoological Systematics and Evolutionary Research, 44: 193–199.

Shokita, S., 1990. Inland-water decapods and their distribution in Iriomote Island of the Ryukyu Islands. In: Environment Agency (Nature Conservation Bureau) (ed.), Study of Essential Factors for Preservation of Wildlife in Nansei Islands. Environment Agency (Nature Conservation Bureau), Tokyo, 305–317. (in Japanese with English summary and captions)

Stimpson, W., 1858. Prodromus descriptionis animalium evertebratorum, quae in Expeditione ad Oceanum Pacificum Septentrionalem, a Republica Federate missa, Cadwaladaro Ringgold et Johanne Rodgers Ducibus, observavit et descripsit. Pars V. Crustacea Ocypodoidea. Proceedings of the Academy of Natural Science of Philadelphia, 10: 93–110.

Takeda, M., & Nunomura, N., 1976. Crabs collected by the Melanesia Expedition of the Osaka Museum of Natural History, 1958. Bulletin of the Osaka Museum of Natural History, 30: 61–92.

Tesch, J. J., 1918. The Decapoda Brachyura of the Siboga Expedition, I. Hymenosomidae, Retroplumidae, Ocypodidae, Grapsidae and Gecarcinidae. Siboga-expeditie, 39(c): 1–148, pls. 1–6.

Yamaguchi, T., Takeda, M., & Tokudome, K.,

1976. A list of crabs collected in the vicinity of the Aitsu Marine Biological Station and a preliminary report on the cheliped asymmetry of the crabs. Calanus, 5: 31–46. (in Japanese)

———, Harada, K., Takeda, M, & Kikuchi, T., 1987. Crab fauna of the Amakusa Islands. Calanus, 10: 1–71. (in Japanese with English abstract)

Yeo, D. C. J., Rahayu, D. L., & Ng, P. K. L., 2004. Brachyura (Crustacea) of the Anambas Expedition 2002. Raffles Bulletin of Zoology, Supplement, 11: 79–88.

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